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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to a liquid crystal display, more, makes the black matrix of a desired particular part small using wide viewing angle art, or removes the black matrix in details, and relates to the liquid crystal display which raised the numerical aperture.

[0002]

[Description of the Prior Art]As everyone knows, the conventional liquid crystal display is said for it to be the greatest fault that this has a narrow angle of visibility although most TN (Twisted Nematic) modes are applied. It applies for the fringe field switching (FFS:Fringe Field Switching) mode liquid crystal display for improvement in an angle of visibility. In order to prevent the color gap classified by angle of visibility by a single domain, it applies for the FFS mode liquid crystal display in which hook structure has been improved.

[0003]However, in the conventional structure for which it existing-applied, even if the OFF state voltage equivalent to 0V is impressed to a picture element electrode and a counter electrode, in order to consider other pixels as one, a specific signal is continuously impressed to a data bus line. Therefore, the noise field (Noise Field) is formed between a data bus line and a picture element electrode or between a data bus line and a counter electrode, thereby, a liquid crystal element is isolated from a polarization axis, and light is revealed in this portion. In order to intercept this revealed light, black-matrix (BM:Black Matrix) patterning of a large field must be performed to an upper board, and this causes the result which induces reduction in a numerical aperture by a panel.

[0004]Since a black matrix is designed in consideration of the assembly margin of the upper part and a lower board, thereby, a numerical aperture decreases and has an adverse effect on high-intensity realization. Drawing 1, drawing 2, and drawing 3 are the figures for explaining the problem of structure conventionally.

[0005]Drawing 1 is a figure showing the pixel structure in the conventional FFS mode. Drawing 2 is a figure showing the liquid crystal element which makes a noise field and a specific angle. Drawing 3 is a figure showing the relation between a liquid crystal element and a polarizing plate.

[0006]In the case of the liquid crystal of shade, rubbing is carried out at 12° to the gate bus line 2, in the case of the liquid crystal of the sun, rubbing will be carried out at 78° to the gate bus line 2, and the early liquid crystal element 3 will be in agreement with rubbing direction A, in order to obtain the greatest transmissivity, if drawing 1, drawing 2, and drawing 3 are referred to.

[0007]Under the present circumstances, the noise field 10 is formed between the data bus line 4 and the picture element electrode 6 or between the data bus line 4 and the counter electrode 8.

[0008]It is for drawing 2 explaining an operation on the noise field 10 and the noise field 10 of the liquid crystal element 3 which makes a specific angle, In the case of the liquid crystal of shade, the noise field 10 and the major axis of the liquid crystal element 3 cross at right angles, and is arranged, and, in the case of the liquid crystal of the sun, the major axis of the liquid crystal element 3 is arranged in parallel with the noise field 10. As a result, as shown in drawing 3, the liquid crystal element 3 will isolate only a specific angle from the polarization axis of a polarizing plate, and this will act as leak light near the data line 4 at the time of OFF (OFF).

[0009]Drawing 4 shows the sectional view of the conventional liquid crystal display structure. As explained above, the liquid crystal element 3 will be isolated from the polarization axis of the polarizing plate 12 by the noise field 10 between the data bus line 4 and the picture element electrode 6 or between the data bus line 4 and the counter electrode 8. In order for this to prevent the leak light generated near the data bus line 4, on the data bus line 4 of an upper board, 22 layers of black matrices with a wide width of about 27 micrometers must be provided.

[0010]On the gate bus line 2, black-matrix 22 about 500-micrometer field must be provided. This has the demerit in which decrease a numerical aperture and the luminosity of a panel is reduced as a result. Similarly, it has the problem which also mentioned above the conventional yne plain switching (IPS:In-Plane Switching) mode.

[0011]

[Problem(s) to be Solved by the Invention]If the direction of a noise field and the rubbing direction of this invention [especially] of the liquid crystal of the sun correspond in IPS and FFS mode which are standard black (Normally Black) mode, Even if a noise field acts, a liquid crystal element is not isolated from the polarization axis of a polarizing plate, but always

maintains a dark (Dark) state, because the major axis of a liquid crystal element is correctly in agreement with the direction of a noise field. Therefore, in order to intercept an optical disclosure of this portion, this invention does not need to provide the black matrix layer of a large field, and removes the black matrix of this portion, or forms the width of a black matrix narrowly. A numerical aperture increases relatively and it aims at providing the liquid crystal display which can realize high-intensity.

[0012]

[Means for Solving the Problem] In order to attain said purpose, a liquid crystal display concerning this invention, A lower board and an upper board which counter mutually, and a counter electrode formed on a lower board, In a liquid crystal display containing a picture element electrode formed by intervening in an insulator layer on a counter electrode, a lower polarizing plate and a top polarizing plate which were attached to the outside of a lower board and an upper board, respectively, a gate bus line, and a data bus line, A rubbing direction of a lower board is in agreement with the direction of a noise field formed between a data bus line, a picture element electrode, or a counter electrode and between a gate bus line, a picture element electrode, or a counter electrode.

[0013] Preferably, a counter electrode is a box gestalt which consists of the 1st yne JUUMU and tin oxide (ITO), and a picture element electrode, It has fringe field switching (FFS) mode structure by patterning the 2nd ITO, and being formed by the shape of an ancyloid in one sub pixel, or forming /shape and ** shape according to a sub pixel by turns.

[0014] A counter electrode and a picture element electrode are formed with opaque metal, pattern a counter electrode and a picture element electrode, respectively, and are formed by the shape of an ancyloid in one sub pixel, Or /shape and ** shape are formed according to a sub pixel by turns, and it can apply also to yne plain switching (IPS) mode structure.

[0015] In a liquid crystal display of this invention, a rubbing direction of a lower board, It is parallel to a gate bus line, and a noise field is formed between a data bus line and a counter electrode or in either one of between a data bus line and a picture element electrode, and forms a black matrix of an upper board narrowly on a data bus line.

[0016] Width of a black matrix of an upper board is smaller than distance between counter electrodes formed via a data bus line preferably, or width of a black matrix of an upper board is 6 micrometers or less identically and more preferably. When a rubbing direction of a lower board is parallel to a gate bus line, it is not necessary to form a black matrix of an upper board.

[0017] On the other hand, when a rubbing direction of a lower board lies at right angles to a gate bus line, a noise field is formed between a gate bus line, a counter electrode, or a picture element electrode, and on a gate bus line, an upper board black matrix is smaller than width of a gate bus line, or is formed identically.

[0018]When a rubbing direction of an upper board lies at right angles to a gate bus line, a black matrix of an upper board can be removed and transmissivity can be raised.

[0019]A rubbing direction of an upper board is the parallel direction of non parallel or either to a rubbing direction of a lower board. As for a polarization axis of a lower polarizing plate, it is preferred that it is in agreement with a rubbing direction of a lower board. As for an absorption axis of a top polarizing plate, it is preferred to intersect perpendicularly with a rubbing direction of a lower board, and to be formed.

[0020]

[Embodiment of the Invention]Hereafter, with reference to an attached drawing, the desirable example of this invention is described in detail. Drawing 5, drawing 6, and drawing 7 are the figures showing the structure of the liquid crystal display concerning one example of this invention, and drawing 8 is a sectional side elevation showing the liquid crystal display concerning one example of this invention.

[0021]When these figures are referred to, a liquid crystal element and 4 the reference mark 3 A data bus line, 6' -- a picture element electrode and 8' -- a counter electrode and 12 -- a lower polarizing plate and 14 -- a lower board and 16 -- an insulator layer, and 18 and 18 -- a black matrix (BM) and 24 show an upper board, 26 shows the rear face ITO, and, as for the Oba coat (O/C) and 22', an orienting film and 20 show a top polarizing plate respectively 28.

[0022]In the composition of this invention, counter electrode 8' of the box gestalt which consists of the 1st ITO fundamentally, the gate bus line 2, the counter electrode bus line 7 and the data bus line 4, and TFT are constituted as usual. However, in order to compensate the refractive index of the liquid crystal element 3 and to solve the problem of a color gap, an ancyloid-like pattern is formed within one sub pixel using picture element electrode 6' which consists of the 2nd ITO, or /shape and ** shape are formed according to a sub pixel by turns within one pixel.

[0023]In this case, rubbing of the lower board 14 can be realized by the two methods of being a rectangular cross in parallel with the gate bus line 2, and rubbing of the rubbing of the upper board 24 is carried out non parallel or in parallel to the rubbing direction of the lower board 14. The polarization axis of the lower polarizing plate 12 attached to the outside of the lower board 14, The absorption axis of the top polarizing plate 28 which coincided with the rubbing direction of the lower board 14, and was attached to the outside of the upper board 24 forms the standard black mode which will be in a dark state at the time of no impressing of voltage by attaching so that it may become a rubbing direction of the lower board 14, and a rectangular cross.

[0024]general -- a noise field -- ten -- a data bus line -- four -- a picture element electrode -- six -- ' -- or -- a counter electrode -- eight -- ' -- between -- moreover -- a gate bus line -- two -- a picture element electrode -- six -- ' -- or -- a counter electrode -- eight -- ' -- between -- forming -

- having . When carrying out rubbing to parallel with the gate bus line 2, a rubbing direction is in agreement with the direction of the noise field 10 which acts between the data bus line 4, picture element electrode 6', or counter electrode 8'.

[0025]It intersects perpendicularly to the gate bus line 2, and when carrying out rubbing, a rubbing direction is in agreement with the direction of the noise field 10 which acts between the gate bus line 2, picture element electrode 6', or counter electrode 8'. As a result, when using the liquid crystal of the sun, the major axis of the liquid crystal element 3 is arranged in the direction which carried out rubbing. In this case, since the self-polarization of the liquid crystal element 3 by which it is generated by an electric field is formed in the termination of the major axis of the liquid crystal element 3, even if the noise field 10 acts, when a rubbing direction and the direction of the noise field 10 are in agreement, the liquid crystal element 3 is not influenced by the noise field 10.

[0026]Therefore, since the polarization axis of the lower polarizing plate 12 and the major axis of the liquid crystal element 3 are not isolated, it is not necessary to provide the black matrix (22 of drawing 4) of a large field like conventional technology. Therefore, in the field a rubbing direction and whose direction of the noise field 10 correspond in the liquid crystal of the sun. If black-matrix 22' of an upper board is narrowly formed on the data bus line 4 or the gate bus line 2 in consideration of an assembly margin about abbreviated 4micrometer or there is no fear of a color gap at the time of a white, black-matrix 22' of a specific site is also omissible.

[0027]When it has the IPS mode structure which similarly formed counter electrode 8' and picture element electrode 6' with opaque metal, patterned counter electrode 8' and picture element electrode 6', respectively, and formed the shape of an ancyloid in one sub pixel; or formed /shape and ** shape according to the sub pixel by turns, it is also the same as that of the above.

[0028]For example, to said gate bus line 2, with this structure, **45 degrees or less of angles after which picture element electrode 6' which consists of the 2nd ITO was patterned, and the slit was patterned are patterned so that it may become **12 degrees more correctly, so that clearly from drawing 5.

[0029]Rubbing of the rubbing direction is carried out in parallel to the gate bus line 2 by the case where the liquid crystal of the sun is used for this structure. in this case -- a sub pixel -- a picture element electrode -- six -- ' -- a counter electrode -- eight -- ' -- between -- **** -- zero -- V -- OFF -- the time -- said -- a data bus line -- four -- a picture element electrode -- six -- ' -- between -- or -- a data bus line -- four -- a counter electrode -- eight -- ' -- between -- a noise field -- ten -- acting -- ***** .

[0030]It turns out that the noise field 10 is a detailed enlarged drawing of data bus line 4 portion which acts, and the rubbing direction of the liquid crystal of the sun and the direction of drawing 6 of the noise field 10 correspond.

[0031]Even if, as for the major axis of the liquid crystal element 3, the noise field 10 acts in this case so that clearly from drawing 7, it will not be isolated from the polarization axis of the lower polarizing plate 12, and leak light does not occur with standard black structure as a result.

[0032]Therefore, like drawing 8 the width of black-matrix 22' of an upper board, counter electrode 8' formed via the data bus line 4, and counter electrode 8^{''} -- identically [it is smaller than the distance of a between or], it is smaller than 21 micrometers, or can decrease to about 4 micrometers same more preferably. In this case, though incorrect alignment (misalign) arises in the assembly time of the upper and a lower substrate, reduction in a numerical aperture is hardly affected.

[0033]On the other hand, drawing 9 is a sectional side elevation showing the liquid crystal display concerning other examples of this invention. If there is no fear of a color gap at the time of a white as shown in drawing 9, it is also possible to remove thoroughly the black matrix (22' of 22 or drawing 8 of drawing 4) of a superior lamella in the upper part of the data bus line 4. In this structure, the R.G.B resin 30 can be superimposed, transmissivity can be decreased relatively, and the function of a black matrix can be replaced. In this case, reduction of the numerical aperture by incorrect alignment does not arise in the assembly time of the upper and a lower substrate.

[0034]In other examples of this invention, not only the data bus line 4 top mentioned above but the black matrix layer on the gate bus line 2 can reduce width, or can remove it. In this case, array structure is the same as that of the already explained structure, patterns picture element electrode 6' which consists of the 2nd ITO, and forms an ancylod-like pattern within one sub pixel, or forms /shape and ** shape according to a sub pixel by turns within one pixel.

[0035]To the gate bus line 2, rubbing of 14 of a lower board intersects perpendicularly, rubbing is carried out, and rubbing of the rubbing of the upper board 24 is carried out non parallel or in parallel to the rubbing direction of the lower board 14.

[0036]The polarization axis of the lower polarizing plate 12 attached to the outside of the lower board 14, The absorption axis of the top polarizing plate 28 which coincided with the rubbing direction of the lower board 14, and was attached to the outside of the upper board 24 forms the standard black mode which will be in a dark state at the time of no impressing of voltage by attaching so that it may intersect perpendicularly with the rubbing direction of the lower board 14. In this case, the noise field 10 acts between the gate bus line 2, picture element electrode 6', or counter electrode 8'.

[0037]However, if a rubbing direction and the direction of the noise field 10 are in agreement, When using the liquid crystal of the sun as a result, the self-polarization of the liquid crystal element 3 which the major axis of the liquid crystal element 3 is arranged in the direction which carried out rubbing, and generates by an electric field in this case, Even if it is formed in the termination of the major axis of the liquid crystal element 3 and the noise field 10 acts, when a

rubbing direction and the direction of the noise field 10 are in agreement, the liquid crystal element 3 is not influenced by the noise field 10.

[0038]Therefore, since the polarization axis of the lower polarizing plate 12 and the major axis of the liquid crystal element 3 are not isolated, it is not necessary to provide the black matrix layer of a large field like conventional technology. Therefore, it is narrow in the width of a black matrix on the gate bus line 2. As long as it is smaller than 30 micrometers, it forms in about 4 micrometers preferably identically identically [it is smaller than the width of the abbreviated gate bus line 2, or] or there is no fear of a color gap at the time of a white, the black matrix of a specific site may be omitted.

[0039]In said structure, the R.G.B resin 30 can be superimposed, transmissivity can be decreased relatively, and the function of a black matrix can be replaced. However, since the field where the direction and rubbing direction of the gate bus line 2 of the noise field 10 do not correspond exists, the black-matrix design to this portion should be taken into consideration.

[0040]When it has the IPS mode structure which similarly formed counter electrode 8' and picture element electrode 6' with opaque metal, patterned counter electrode 8' and picture element electrode 6', respectively, and formed the shape of an ancyloid in one sub pixel, or formed /shape and ** shape according to the sub pixel by turns, it is also the same as that of the above.

[0041]

[Effect of the Invention]As explained above, the liquid crystal display whose numerical aperture concerning this invention improved, Raised the numerical aperture, locate a picture element electrode and a counter electrode in a lower board especially, and in the IPS mode and FFS mode using a parallel electric field by improvement in a numerical aperture. By making panel brightness increase, it can be applied very in favor of the product in which the high-intensity characteristics, such as liquid crystal TV, are demanded.

[0042]The liquid crystal display whose numerical aperture concerning the example of this invention improved is not limited to said example, within limits which do not deviate from the technical gist, can change many things and can be carried out.

[Translation done.]